

CHAPTER 2C
UNDERGROUND PIPE SYSTEMS

2C-01. GENERAL

This chapter covers excavation, trenching, backfilling, and laying of underground pipe systems to a point within five feet of buildings and structures. The types of underground pipe systems considered are as follows: Water, storm subdrainage, sanitary, fuel, gas, steam, high and low temperature hot water.

a. Plans. Specifications, and Layout

Prior to the start of field construction, the plans and specifications should be thoroughly reviewed. The QC rep must check and review isolation of any utility lines that are to be worked on. Also, QCR must check and review the permanent disconnection and capping of critical utility lines such as; natural gas, fuel oil, LPG, etc., that are to be abandoned.

(1) Observe existing utilities and all possible interference with existing systems.

(2) Confer with local utility agents to ascertain that all utilities are indicated on the contract drawings. Utilities not shown on contract drawings should be entered on record drawings.

(3) Check all electrical facilities, both aerial and underground, in accordance with EP 414-1-261, Vol 4.

b. Accessibility of Valves. Hydrants, and Manholes

All valves, hydrants, and manholes should be constructed in such manner that they can be utilized in the future. Hydrants should be accessible for operation.

c. Lines and Grades

Lines and grades should be established and staked, and reference bench marks should be set before any excavation or pipe-laying operations.

(1) Check each type of utility being installed within a project for conflict as to the layout and elevations at each point of crossing.

(2) Check for conflict with existing utilities.

d. Connections to Existing Utilities

Plan and coordinate connections to existing utilities. Under no conditions will an existing utility service be interrupted without full coordination with the operator of such service.

e. Interference

Hold traffic interference to a minimum when installing utilities in or under walks, streets, or railroads. QA/QC should ensure that jacking and boring of pipe, where required by the contract, is carried out in a manner so as not to disrupt traffic or other surface activities.

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(1) Determine that materials are on hand and that work is organized, so that interference will be held to a minimum.

(2) Insure that warning signs, barricades, and obstruction lights are placed and that regular traffic is not tied up excessively.

(3) Traffic interruptions and detours must be coordinated with the facility or agency responsible for the service.

f. Damages

See that completed pipe installations are not damaged by movement of construction equipment over or near pipe.

g. Testing

Pressure tests shall be performed prior to backfilling for visual inspection of joints. Alignment tests on all pipes and drain lines are made before backfill is completed. Test results shall be recorded. Check to:

(1) Inspect every joint.

(2) Assure that corrective action is in accordance with requirements.

2C-02. PIPES AND FITTINGS

a. Material Compliance

(1) Determine the quality of all material delivered to the work site for specification compliance.

(a) Pipe, pipe fittings, valves and other components should be checked to insure that they carry the appropriate stamp and standards organization designations such as ASTM or ASME.

(2) Compare official submittals with material brought to the job. Check labeling for type, grade, strength, classification and determine size and condition of materials. Make sure that pipe fittings, such as tees, ells, and couplings, correspond to the weight of pipe, and are made in the U.S.A.

(3) verify the quality of miscellaneous items such as valves, service boxes, stops, special connections, tapped tees, etc.

b. Handling and Storage

(1) See that pipes and fittings are handled with the proper tools and equipment. Do not permit dragging and handling of pipe with chains, wire ropes, etc.

(2) Check for damaged pipes, fittings, and pipe coating. Reject all damaged materials promptly, and have rejected materials removed from the job site immediately.

(3) Make sure adequate and accessible storage area has been provided.

(3) Determine requirements for repairing damaged surface coatings.

c. Field Coating

- (1) Check the availability of an approved coating test device.
- (2) Check for breaks and abrasions of pipe coating.
- (4) Implement requirements for cleaning of surfaces before coating.
- (5) Follow the requirement for painting with primer and sealer.
- (6) Check for the requirement to coat edges or ends of pipe and bolt threads.

d. Laying Pipes - General

- (1) Check the gradient, line, and grade of the pipeline trench or bed before laying proceeds and after completion of each section.
- (2) Observe method of jointing permitted.
- (3) Use pipe manufacturers installation information. Where there is a difference between this information and the contract specifications, this difference should be called to the attention of your supervisor.
- (4) Check for cleanliness of pipe (especially joints) during placement and after completion. Cover pipe openings with temporary protection.
- (5) Insure that all pipe to be placed on earth is placed on dry, firm soil.
- (6) Check for obstructions in pipe, such as pipe plugs, debris, etc.

e. Water lines

- (1) Grade lines to avoid high points as much as possible. Where high points occur, check specifications for requirements for vacuum and relief valves.
- (2) See that fire hydrants are plumb with pumper nozzle (4 and ½ inch opening) facing the roadway. Check location of hydrant shut-off valve and post indicator valve (no shutoff valve between the PIV and the building it serves.)
- (3) Measure height of the lowest nozzle above finish grade. An 18-inch clearance is required.
- (4) Check that fire hydrant threads conform and fit the hose or fire fighting equipment which will be connected to them.
- (5) Observe the hydrant barrel drain.
- (a) Plug the drain in locations of high ground water where the hydrant is specified to have no drain. All hydrant valves must sit on a 15" by 4" thick concrete pad.

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(b) In area where the ground water is low, the drain plug must be removed and drainage aggregate (18 inches of crushed stone) provided.

(6) A well installed water main does not move.

(a) Check thrust blocking and/or tie rods.

(b) Check for movement at joints, bands, dead ends and hydrants.

(c) Check wedging at all fittings.

(7) Require the hydrostatic pressure test and specified leakage tests.

(8) Do not omit the sterilization phase of the construction work on water lines.

(a) Main to be thoroughly flushed with water until all mud and debris have been removed.

(b) Add disinfecting agent in easily applied form and recommended dosage.

(c) Solution to remain in contact with line at least 8 and preferably 24 hours.

(d) There should be no less than 10 ppm residual at extreme end of line at end of contact period.

(e) Flush entire system thoroughly.

(9) Insure that valves are accessible and try turning the valve nut after backfilling is completed.

(10) Check distance requirements between parallel and crossing water and waste piping.

f. Fuel Gas Lines

(1) Do not permit lines to be buried under buildings, nor in trenches with other utilities.

(2) Enforce safety regulations rigidly during construction of gas lines.

(3) Check and recheck the area with a detector for an explosive atmosphere.

(4) When there is indication of an explosive condition, do not commence work until the explosive condition has been cleared.

(5) Install gas pipes above other utilities which they cross, and with a minimum cover of 2 feet. Pipe under pavements or heavily traveled areas will be encased or located deep enough so that there will be no damage from heavy traffic.

(6) Check cleanliness of pipe before lowering into trench.

(7) Check pipe coating for damage during connection, laying, and backfilling operations. Permit coated piping to be handled only by hand or with nonmetallic flexible slings.

(8) Keep pipe clean during installation by careful handling and by keeping ends of pipe closed.

g. Sanitary Sewers

(1) Check distance separating sewers from water line. Always install sewer or force main below water line if the lines are within 6 feet horizontally, unless special provisions are taken at crossings; otherwise spacing must be at least 10 feet

horizontally. Check for special requirements where sewer lines or force mains cross above water lines. Require leakage tests for sanitary sewers and force mains. QA/QC to verify that special backfill and compaction requirements for plastic pipe have been followed.

(2) Check to see that spigot end of pipe is pointed downstream in pipeline.

(3) Check that uniform grade is maintained between man-holes. Assure that top elevation of manhole is flush with paving grades or higher than finished grade of ground surrounding area, as specified.

(4) There are specific safety precautions to be taken when working in sewers. Sewer gas may be explosive or incapable of supporting life. Check need for assigning at least two men to the work.

(5) Handtools must be used to round the trench bottom and dig bell holes so that at least the bottom quadrant of the pipe rests firmly on undisturbed soil.

h. Storm Sewers

(1) Check that installation is performed by proceeding upgrade with spigot or tongue end of pipes pointing in the direction of flow.

(2) Check the installation of all fittings, joints, connections at manholes, and connections to existing facilities.

(3) Check grade, elevation, and finish of paved inverts.

(4) Check that elliptical pipe sections are handled carefully in transporting, storing and installing.

(5) Check for installation of all subdrain tile as shown on plans.

(6) Where watertight joints are required, see that hydrostatic test requirements are met, and that rubber gaskets are not affixed more than 24 hours prior to pipe installation and are protected from sun, dust, and other deleterious agents.

(7) provide covering to prevent the entrance of earth into the pipe.

(8) Require shaping the trench bottom as for sanitary sewers.

i. Heat Distribution Lines

(1) All heat distribution piping is subject to expansion

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and contraction. Check that all lines are straight, both vertically and horizontally.

(2) Expansion of piping will be absorbed by expansion joints or fabricated pipe loops. There must be room for the pipe loop to move and for maintenance.

(3) Verify strength, security, and proper placement of anchors and supports.

(4) Inspect rigid installation of anchors.

(5) Require uniform pitch of steam pipe. Trap all low points.

(6) Follow the manufacturer's recommended installation procedure for the insulation materials, unless there are specific changes on the approved shop drawings.

(7) Store and protect insulation from the weather.

(8) Keep underground pipe conduit system dry during and after construction.

(9) Examine waterproofing very carefully. There are many details for both field applied and factory applied waterproofing to protect the insulation.

(10) Valve pits should be watertight and have sumps or drains, if not advise your supervisor. Check for proper valves, fittings, supports, seals around pit openings, casing, drain, vents, sump, aluminum jacketing over insulation, ladder, etc.

(11) Valve pits should also be checked to insure that they are of the required size and that valves, flanges and other components have been located as to be accessible and to provide sufficient space for ease of maintenance.

(12) Check welding of pipe lines for compliance with specification requirements and the applicable codes.

(13) Insure that all changes in direction are done with approved type fittings.

(14) Check welds or metal casing on underground steam lines for leaks and holidays in asphalt coatings.

(15) See that the Class A or B underground system materials have been tested for acceptability.

(16) Require that all low points in the system are drained and high points are vented.

(17) Assure that the field testing is satisfactorily performed, including hydrostatic, visual and holiday detector tests.

(18) Check for removal of ground water from system.

j. Fuel Lines

(1) Fuel lines in this section pertain to underground liquid petroleum systems.

(2) Check drain connections at low points and air releases at high points.

(3) Check that field application of covering on joints is not done until the pneumatic pressure test has been conducted and the joints proved satisfactory.

(4) Check if screens and filter elements are installed; check mesh and material; check installation for proper direction of flow; and check clearances for removal of screen and access to drain connection.

(5) Vapors of fuel may accumulate in pits or enclosed areas and can cause serious explosions.

(a) Provide adequate ventilation during operation in a liquid fuel area.

(b) Prohibit open fires, sparks, or static electricity in the vicinity of vapors which may be explosive.

(c) Check by use of a detector for explosive atmosphere.

2C-03. JOINTING OF PIPES

a. General

(1) Check to see that all jointing surfaces are kept clean. Check to insure that pipes of different materials, densities or manufacturers can and are being properly joined. For example, heat fusion of plastic pipe of different densities is problematic. This piping should be joined with mechanical couplings to insure a leak proof connection.

(2) Do not join pipes in mud and water.

(3) Constantly be on the alert to check tightness of joints.

b. Hot-pour Joints

(1) Hot-pour joints must be clean and dry. The presence of moisture may cause explosion and possible injury.

(2) Check for uniformity of annular space.

(3) Check method of application and make sure all joints are adequately filled.

(4) Check temperature of the compound.

c. Poured Lead Joints

(1) Check packing for uniformity and tightness.

(2) Check depth and amount of lead being placed in joints.

(3) Check the pouring operation for method of filling and for one continuous pour.

(4) Check driving during caulking. If lead is permitted to be displaced to a depth greater than 1/4 inch, the joint should be remade.

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d. Flexible Joints

(1) Check for approved material, make, type, and number of splices. etc.

(2) Check placing and positioning of flexible gasket.

(3) Check depth of gasket with a gauge.

(4) Check use of lubricant.

(5) Make hydrostatic test as soon as possible.

e. Tapered End Couplings

Drive tapered end couplings up tight when joining bituminous fiber pipe.

f. Cement Mortar Joints

(1) Determine specific requirements for types of joints, whether Oakum, Diaper band, etc.

(2) Insure that mortar meets requirements of specifications.

(3) Observe that the jointing operation will completely fill joints and form a bond on the outside.

(4) Cure cement mortar joints.

(5) Remove excess grout from inside and outside of pipe.

g. Pipe Threads

(1) Cut pipe threads with sharp tools.

(2) provide proper length thread; the pipe taper is lost by overlength threading.

(3) Ream pipe flush on the inside surface.

(4) Apply joint compound to the threads on the pipe, not to the fittings.

(5) Make up all joints tightly.

h. Copper Tubing Joints

(1) Correlate types of pipes and fittings used against types required.

(2) Cut copper tubing off square and remove burrs.

(3) Insure clean tubing before fluxing and soldering.

(4) Check type of tools used for flaring compression type joints.

i. Welded Joints

(1) Inspect welders* qualifications and approved procedure.

(2) Prior to any welding, obtain the code designation assigned to each certified welder to insure that welded joints are stamped with the welder's code and can be properly identified.

(3) Fabricate and weld as much as possible before lowering pipe into trench.

(4) Check against possible cave-in when welding in trench.

(5) Explore for explosive gases within pipes and before welding in fueling areas.

(6) Check pipe ends for bevel.

(7) Make a very careful inspection of welds in hard to reach areas.

(8) Remove all welding slag before visual inspection.

j. Mechanical Joints in Manholes

Install in accordance with manufacturer's instructions.

k. Flanged Joints in Manholes

Install gaskets, bolts and assure that flanges are not damaged. Use proper bolt torquing procedures.

l. Corrugated Banding

(1) Laps of all circumferential joints in the pipe should provide that the outside lap be on the downstream side of the joint with the longitudinal laps on the side of the in-place pipe.

(2) All markings indicating the top of the pipe should coincide with the specified alignment of the pipe.

(3) While the connecting band is being placed, assure that the band is going to fit tightly.

(4) Check for the requirement, or necessity, to use bituminous material at the joint after jointing.

m. Caps or Plugs

(1) Close open ends of pipe when work is not in progress.

(2) Keep pipelines clean of all debris, rodents, or water.

2C-04. MANHOLES, CONCRETE CRADLES AND ENCASEMENTS

a. Materials - Check material requirements with delivered materials at the preparatory inspection.

b. Construction

(1) Check dimensions and layout.

(2) Check invert elevations and details of the invert channels in manholes.

(3) Check placement of material such as concrete, reinforcement, brick, block, plaster, frames and covers, rungs, etc., for the same workmanship as for other structures.

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(4) See that manholes are not obstructed by dumped waste concrete or other construction material.

2C-05. EXCAVATION, TRENCHING AND BACKFILLING

a. Excavation - Existing underground utilities will be carefully excavated and protected. Existing utilities will be suitably supported to prevent damage to them and to prevent transferring any direct load on to the new piping system below.

(1) Check need for shoring or excavate to required side slope.

(2) Report all damaged existing utilities to your supervisor immediately to determine corrective measures.

(3) Note location of all unknown or unreported utilities for inclusion on revised utility plan.

(4) Determine that access steps or ladders are provided in trenches, where necessary, and that they are maintained in safe condition.

b. Trenching - Begin trench excavation for sewers at the lower end of the line and proceed upgrade to protect the work from possible flooding, unless job conditions prohibit.

(1) Check specifications and job requirements for maximum width of trench and minimum depth of pipe.

(2) Check bed of the trench for grade and suitability of materials before any pipe is laid. If the trench is overexcavated, bring the bed to grade and compact. When encountering rock excavations, check the minimum overdepth specified and check that backfilling is performed with select bedding material.

(3) Keep water from the trenches during construction. Use pumps or a well point system.

(4) Check that final hand grading precedes pipe laying by no more than the amount of pipe that can be installed the same day. Special conditions may limit hand graded distance to a few feet.

(5) Check excavation of bottom of trench. Is it graded and shaped to bottom quadrant of sewer pipe, and has excavation under all bells been performed as specified?

(6) Inspect distance between potable water lines and sanitary sewer trenches for minimum allowable clearance.

(7) Check pipe-handling procedures and do not allow loads being swung over the heads of workmen.

c. Backfilling - QC to ensure that special care is taken when backfilling around ductile iron pipe that has been encased in a polyethelene sleeve. Require leakage tests for sanitary sewers. QC to verify that specific backfill and compaction requirements for plastic pipe have been followed.

(1) Permit placement of backfill only between pipe joint locations until all lines have been tested and/or approved, unless job conditions require otherwise. In the case of pressure testing, place sufficient backfill material to prevent pipes from moving out of place. In the case of wrapped and coated piping, do not permit any backfilling until the coating at welds and fittings has been completed and the entire coating tested for holidays. Assure that backfill in contact with the piping does not injure protective coatings. Make sure that all lines are located on as-built drawings before backfilling.

(2) Check backfill material, assuring placement in uniform layers on each side of the pipeline.

(3) Insure removal of foreign materials and large stones prior to backfilling.

(4) Backfill operation check:

(a) Thickness of each layer for moisture content and compaction. Especially watch for compaction around lower portion of pipe, and watch for any movement of pipe.

(b) Do not machine compact fill on top of a pipeline until required minimum cover has been placed.

(c) That there are no large or sharp rocks used.

(d) The maximum size of stones permitted.

(e) Assure that all requirements are clearly understood by QC Representative. Backcheck for validation with density testing when necessary.

(5) Check sewer lines to manhole after the backfilling operation. Check from manhole for broken pipe, settlement in the line, lateral movement, and cleanliness.

2C-06. SUMMARY

a. The plans and specifications must be rigidly adhered to at all times.

b. During the constructibility review the QA must insure that red-lined as built drawings and system O&M manuals are submitted to the installation as soon as possible after completion of all or each section of the system if the construction is phased. In any case the appropriate "red-lined" drawings and O&M manuals should be given to the installation before any portion of the system is placed in operation or the facility is occupied.

c. All questionable items should be reported to your supervisor.